



LOGANEnergy

The power of fuel cells.

W9132T-05-R-0028

Tyndall AFB, FL
PEM Demonstration Project
Bldg. 914 Bowling Alley
Initial Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY04

Headquarters:

1080 Holcomb Bridge Rd
Suite 100-175
Roswell, GA 30076
Ph (770) 650-6388

Tyndall AFB, FL
Bldg. 914 Bowling Alley - Raptor Lanes

07 April 2006

California:

5680 Adobe Rd
29 Palms, CA 92277
Ph (760) 367-5005

Executive Summary

Under terms of its FY'04 DoD PEM Demonstration Contract with the Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL), LOGANEnergy will install and operate a Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant at Tyndall AFB, FL. The site selected for the one-year demonstration project is the Raptor Bowling Lanes located in building 914. The unit will be electrically configured to provide grid parallel/grid independent service to the building and it will also be thermally integrated with a hot water heater located in the facility mechanical room. Local electrical and mechanical contractors may be hired to provide services as needed to support the installation tasks. Using LPGas as the source fuel, it is anticipated that the project will add **\$3,620.17** in annual energy costs to Tyndall AFB during the period of performance.

The Tyndall POC for this project is:

Gilbert Walker
Energy and Utilities Manager
325th CES/CEC
119 Alabama Avenue
Tyndall AFB, FL 32403
Gilbert.walker@tyndall.af.mil
(850) 283-4715

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at Tyndall AFB, FL

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 Carbonate, Phosphoric Acid Fuel Cell (PAFC) and Proton Exchange Membrane (PEM) fuel cell projects at 21 locations in 12 states, and has agreements to install 15 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP gas unit, and the GenCor 5kW hydrogen fueled standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Vinny Cassala is the Plug Power point of contact for this project. His phone number is (518) 782-7700 ex 1228, and his email address is vincent_cassala@plugpower.com.

4.0 Principal Investigator(s)

Name	Chris Davis	Keith Spitznagel
Title	Chief Operating Officer	Sr. Vice President, Marketing
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388	724.449.4668
Fax	770.650.7317	770.650.7317
Email	cdavis@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Chris Davis	Keith Spitznagel
Title	Chief Operating Officer	Sr. Vice President, Marketing
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388	724.449.4668
Fax	770.650.7317	770.650.7317
Email	cdavis@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

- a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement.

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

- b) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

- c) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxet River, MD.

Plug Power
Mr. Vincent Cassala
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1228

7.0 Host Facility Information



Figure 1: F-22 Raptor Flyover of Tyndall AFB

In December 1940, a site board determined that Flexible Gunnery School No. 9 would be located 12 miles southeast of Panama City, Florida on the East Peninsula. On May 6, 1941, Army and local dignitaries held an official ground breaking for the school. Panama City's mayor, Harry Fannin, dug the first spade full of sand, and Colonel Warren Maxwell, Tyndall's first commander, wielded the first ax on the stubborn palmetto plants, so common on the East Peninsula. The site was covered with pine and palmetto trees, scrub brush, and swamps. Bulldozers worked around the clock to clear the brush and fill in swampy areas.

Although construction was well underway, the base lacked a name. Congressman Bob Sikes suggested naming the school in memory of Lieutenant Francis B. Tyndall. A native of Sewall Point Florida Lieutenant Tyndall was a fighter pilot during World War I and was credited with shooting down four German planes well behind enemy lines in 1918. While inspecting Army fields near Mooresville, North Carolina on July 15, 1930, Tyndall's plane crashed, killing him instantly. On June 13, 1941, the War Department officially named the new installation Tyndall Field.

On December 7, 1941, the first of 2,000 troops arrived at Tyndall Field. Although construction was incomplete, instructors and students began preparing for the first class. The first class of 40 gunnery students began on February 23, 1942. Of the thousands of students passing through the Tyndall gates, the most famous was actor Clark Gable, a student here during 1943.

One common thread between those early years and today's training at Tyndall is foreign student training. It began at Tyndall in 1943 with French Air Force gunnery students being the first class and Chinese students following that year. The last class of foreign students were Chinese Nationals that entered training in 1946. Today, foreign students attend weapons controller training at Tyndall. When World War II ended, Tyndall went through the demobilization process, as did most Army Air units. Fortunes changed as the base fell under the control of the Tactical Air Command in 1946, which lasted only three months. Tyndall then became part of Air University, and in September of 1950, Tyndall became an Air Training Command base. Several schools were assigned, including Weapons Controllers, USAF Air Police, and USAF Instrument Instructor Pilot. Then on January 4, 1951, ATC began aircrew (interceptor) training at Tyndall using F-86, F-89, and F-94 aircraft. This relationship lasted until July 1, 1957, when Tyndall became part of the Air Defense Command, an association that would continue for more than 22 years.

Tyndall began hosting William Tell in 1958, just one year after becoming an Air Defense Command unit. William Tell is the nickname for the USAF Air-to-Air Weapons Meet held bi-annually. Tyndall still hosts the competition, but under the sponsorship of Air Combat Command and with competition from all over the world.

Tyndall's second association with the Tactical Air Command began on October 1, 1979. Over the next few years, modernization, upgrade, and reorganization became the key words around Tyndall. A major reorganization occurred on July 1, 1981, with the activation of the 325th Fighter Weapons Wing. The wing began its mission at Tyndall with the F-101, F-106, and T-33 aircraft, while at the same time phasing out the F-101 and F-106 and preparing for the arrival of Tyndall's first F-15 aircraft in 1983. Over the years, Tyndall gained additional missions as other units were stationed on the base. The Air Force Engineering and Services Center was formed at Tyndall as a part of a major reorganization. In 1991, it was renamed the Air Force Civil Engineering Agency. The 23rd Air Division, renamed the Southeast Air Defense Sector, also relocated to Tyndall. It had the responsibility for the air defense of the southeastern United States.

As the base entered its fiftieth year, Tyndall underwent reorganization in response to the DoD effort to streamline defense management. Headquarters, First Air Force moved from Langley Air Force Base, Virginia, to Tyndall, and the 325th Fighter Wing became the installation host. Transition continued for the base as it transferred from being an Air Combat Command installation to an Air Education and Training Command installation on July 1, 1993. This move emphasized Tyndall's commitment to training. The 325th Fighter Wing remains the sole F-15 air superiority and air battle manager training wing in the United States Air Force.

Things remained calm at Tyndall through the next 9 years. Tyndall saw the dusk of one century and the dawning of a new one as the base moved into the 21st century. The 21st century proved to be momentous for Tyndall AFB. The base was selected as the first home of the Air Force's newest aircraft, the F/A-22 "Raptor." More changes came in 2002 as the Chief of Staff of the Air Force transformed the organizational structure of the 325th Fighter Wing from an objective type wing to a combat organization. This organization moved all maintenance activities under the 325th Maintenance Group and all support activities under the 325th Mission Support Group. Today, "Team Tyndall" stands committed to defend the interests of the United States through training, detection, and deterrence.

8.0 Fuel Cell Site Information

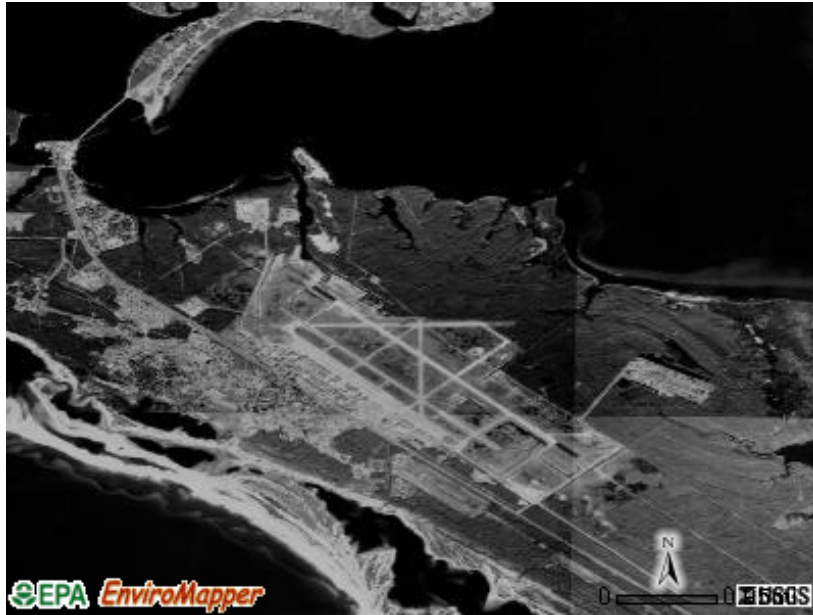


Figure 2: Aerial view of Tyndall AFB

On January 11, 2006, LOGAN representatives met with Tarone Watley, an engineer with the base civil engineering squadron, to perform a fuel cell site evaluation at Tyndall, AFB. Following a tour of the base facilities, the team selected the base bowling alley located in building 914, also known as Raptor Lanes, for this PEM Demonstration Project. The photos in figures 3 and 4 below show further detail of the building elevation and the actual pad site located on the southeast corner of the building.



Figure 3: Raptor bowling lanes



Figure 4: Fuel cell pad site

One Plug Power 5 kW GenSys 5P, operating on LPGas, will be located at this site. The unit will operate for most of the project at a power dispatch set point of 2.5kWh. At this output the GenSys consumes .53 gallons per hour (GPH) HD-5 LPGas, which will be delivered by a service company and stored on site in a 250 gallon tank. Purchase and scheduling of the fuel supply for the project will be the responsibility of Tyndall. In addition Tyndall will be responsible for providing analog tone to the site to provide data and communications and remote start capabilities with the fuel cell through its internal modem. All site permitting requirements will be coordinated with the base Civil Engineering Squadron, and a checklist will be circulated to insure that these tasks are completed prior to beginning the installation.

9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the Gensys5 product commercialization schedule. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary, the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. The photo in Figure 5 at right shows a typical service panel in the electrical closet where the fuel cell will be electrically coupled to the base utility grid. On the wall adjacent to the service panel, LOGAN will attach a new emergency service panel to support dedicated fuel cell loads after consulting with the DoD POC to select the appropriate circuits to transfer to it. The Electric Utility provider at this project site is Gulf Power, a division of the Southern Company.



Figure 5: Typical electrical service panel

10.0 Thermal Recovery System

While operating at a set point of 2.5 kW, the GenSys5P has a heat rate 35,200Btu/H and offloads approximately 7,800Btu/H to the customer heat exchanger. In contrast to other sites, where LOGAN has installed a hot water heater with indirect heating coils, this site will employ a Heliodyne heat exchanger to capture fuel cell waste heat and transfer it into the bowling alley's hot water system (See Figure-6 below). The Heliodyne is a coil within a coil design that provides double wall protection between the heat source and the heat sink in order to prevent contamination of potable water supplies. It was designed primarily for the solar heating industry, but proved to be very adaptable to this installation.



Figure 6: Typical Photo Incorporating a Heliodyne Coil

11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing seen in Figure 7 below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center. LOGAN will provide high-speed Internet access to the fuel cell router through the campus Ethernet. The university will provide local dial tone to support analog communications with the fuel cell modem.

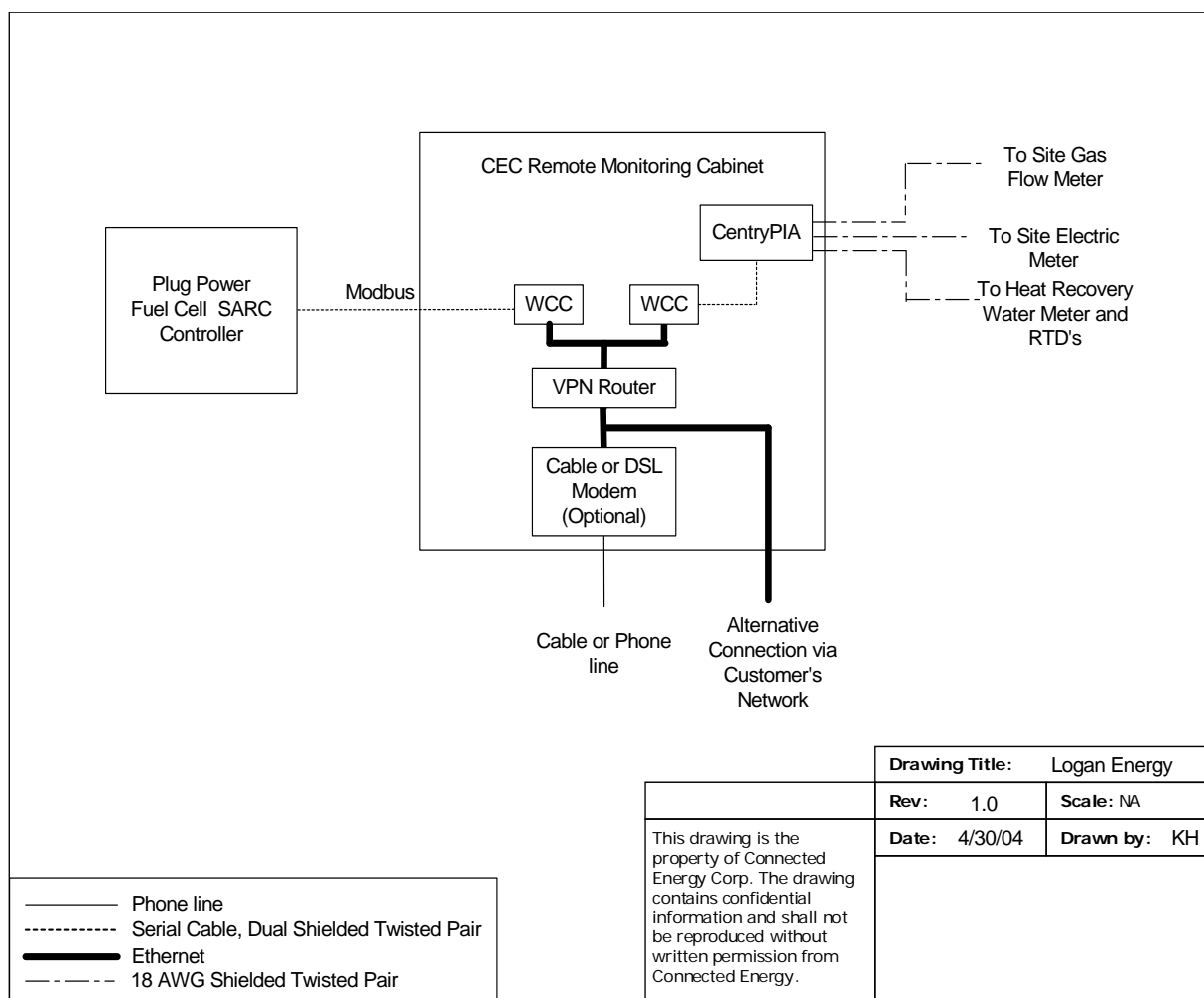


Figure 7: Fuel Cell Remote Monitoring Diagram

12.0 Economic Analysis

Tyndall Air Force Base Building 914 - Bowling Alley PEM Demonstration Project

Project Utility Rates			
1) Water (per 1,000 gallons)	\$	0.90	
2) Utility (per KWH)	\$	0.0630	
3) Propane (per Gal)	\$	1.50	
First Cost		Estimated	Actual
Plug Power 5 kW SU-1		\$ 75,000.00	
Shipping		\$ 3,000.00	
Installation electrical		\$ 3,200.00	
Installation mechanical & thermal		\$ 6,050.00	
Watt Meter, Instrumentation, Web Package		\$ 12,500.00	
Site Prep, labor materials		\$ 2,000.00	
Technical Supervision/Start-up		\$ 2,500.00	
Total		\$ 104,250.00	
Assume Five Year Simple Payback		\$ 20,850.00	\$ -
Forecast Operating Expenses		Volume	\$/ Hr
Propane Gal/ hr @ 2.5kW	0.5300	\$	0.80
Water Gallons per Year	14,016		\$ 12.61
Total Annual Operating Cost			\$ 6,280.39
Economic Summary			
Forecast Annual kWh		19710	
Annual Cost of Operating Power Plant	\$	0.319	kWH
Credit Annual Thermal Recovery Rate		(\$0.072)	kWH
Project Net Operating Cost	\$	0.247	kWH
Displaced Utility cost	\$	0.063	kWH
Energy Savings (Cost)		(\$0.184)	kWH
Annual Energy Savings (Cost)		(\$3,620.17)	

13.0 Kickoff Meeting Information

The project kick-off meeting is tentatively scheduled to occur on April 11 at 13:30 AM EST by teleconference. At that time CERL, LOGAN and Tyndall representatives will conference to discuss the purpose, scope, and conduct of the PEM demonstration project. Attached to this Initial Project Report in the Appendix Section 5 is the conference agenda outlining the specific items that will be covered in the teleconference.

14.0 Status/Timeline

The timeline is included in the Appendix Section 4.

15.0 Appendix

Section 1: Sample form used to qualify the fuel cell for initial start and the project acceptance test.

Installation/Acceptance Test Report

Site: Tyndall AFB Bowling Lanes, Building 914

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed			
Stack Installed			
Stack Coolant Installed			
Air Purged from Stack Coolant			
Radiator Coolant Installed			
Air Purged from Radiator Coolant			
J3 Cable Installed			
J3 Cable Wiring Tested			
Inverter Power Cable Installed			
Inverter Power Polarity Correct			
RS 232 /Modem Cable Installed			
DI Solenoid Cable Installed with Diode			
Natural Gas Pipe Installed			
DI Water / Heat Trace Installed			
Drain Tubing Installed			

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK			
SARC Name Correct			
Start-Up Initiated			
Coolant Leak Checked			
Flammable Gas Leak Checked			
Data Logging to Central Computer			
System Run for 8 Hours with No Failures			

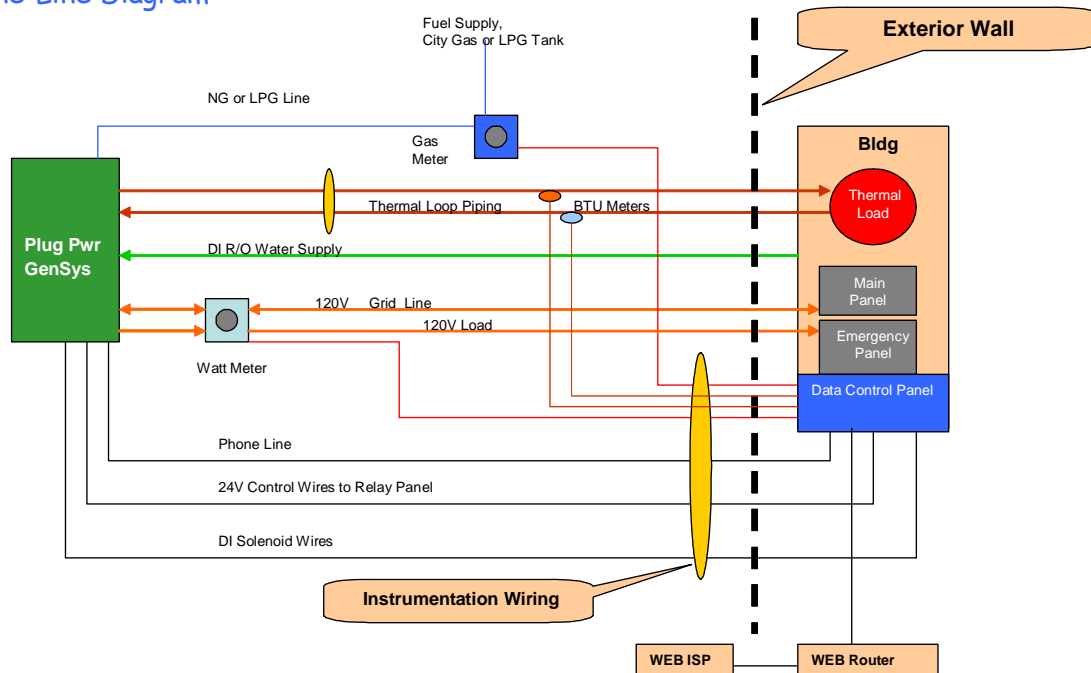
Section 2: Plug Power GenSys5P Specifications

- Dimensions 84 1/2" x 32" x 68 1/4"
- Performance Continuous Power Rating 5kWe (9kWth)
- Power Output 2.5-5kWe (3-9kWth)
- Voltage 120/240 VAC @ 60Hz
- Power Quality IEEE 519, Grid Interconnect IEEE P1547
- Emissions NOX <1ppm...SOX <1ppm
- Noise <60 dBA @ 1 meter
- Operating Conditions Temperature 0°F to 104°F
- Elevation 0 to 6000 feet
- Installation Outdoor
- Electrical Connection, Grid Parallel/Grid Independent
- Fuel, Propane
- Certifications Power Generation, CSA International
- Power Conditioning UL 1741— Electromagnetic Compliance FCC Class B —



Section 3: Installation Line diagram

GenSys Typical Installation One-Line Diagram



Section 4: Tyndall PEM Demonstration Project Timeline

